The Role of Content and Context in Pragmatic Reasoning*

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INTRODUCTION

The aim of this study is to determine the influence of a linguistic form of conditional sentences and the polarity of mayor premises on subject´s ability to reason about conditional rules and their confidence in the selection of correct responses.

The conditional connective "if…then" expresses one of the elementary relation between antecedent and consequent propositions. According to the standard logic, a conditional of the form *"if p ... then q"* is equivalent to *"whenever p ... then q"*. But the *"whenever ... then"* colloquial expressions stresses the deterministic relationship between p and q terms, and the "if…then" colloquial expressions stresses another probabilistic relationship between antecedent and consequent.

The objective of the experiment is to test that conditional reasoning in the abstract content problems varies as a function of the degree of relationship between antecedent and consequent of conditional sentences and their polarity.

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In contrast the syntactic theory, we considered that performance shall generally be better in the *"whenever...then"* than the *"if...then"* rules. In addition, we also expected unbetter confidence for the *"whenever...then"* linguistic form.

EXPERIMENT 1

METHOD

Subjects

Eighty-eight subjects participated in this experiment (50 females and 38 males). Forty-four subjects were allocated at random to each of the two experimental groups. All subjects were students at the college level (mean age 18 years 7 months), at Santiago de Compostela (Spain).

The subjects had no previous experience with this type of tasks. They all acted as unpaid volunteers.

Design

A 2 x 4 x 4 factorial design with repatead measures on the last two factors was used. The three factors were: linguistic form of conditional sentence ("if…then", "whenever…then"), type of conditional rules: Modus Ponens (MP), Modus Tollens (MT), Affirmation of the Consequent (AC) and Denial of the Antecedent (NA) and the polarity, with the four possible combinations of affirmative and negative components (AA, AN, NA NN).

The dependent measures were: a) correct answer to conditional problems and b) security in the subject 's selection responses.

Materials

Four versions of the 32 item conditional reasoning test were constructed by the experimenters. These items represented all the possib1e variations of a basic two-premises conditional arguments according to the type of rule (MP, MT, AC and DA) and the polarity of the components of major premises (AA, AN, NA, NN).

The presentation of the 32 items was randomized and the reasoning problems were presented in this order and in the reverse order (IA-1 vs. A-2; IB-1 vs. IB-2).

Task and Procedure

Subjects were assigned at random to one of the two linguistic forms of the conditional sentences. There were 44 subjects in each condition and they were tested in two experimental sessions.

Within each of these two main groups were given the problems in a randomized order and half of subjects were set the items in reverse order. All subjects were given one version of the testbooklets.

Subjects received written instructions. The subject 's task was assume that the two premises of each conditional argument are true and, on the basis of this knowledge, to select of a list of three alternatives the conclusion followed from the premises.

A second task was to rate the subjective security in these selection of response for each problem. A five-point scale was used, where 5 meant the maximum score and 1 meant the minimum security in the subject's selection responses.

These instructions were read to the subjects and they were asked for reading them again to themselves. Prior to the test problems there were two practice items using conditional inferences. Questions were solicited from the subject to they ensure that they understood the instructions.

Finally, they were allowed to work at their own speed.

Results

There was a significant main effect for the type of rule ($F(3,258) = 70.56$; $p < .0001$) and a significant interactive effect between type of rule x polarity ($F(9, 774) = 5,14$; $p < .0001$). There was no main effect involving the linguistic form of conditional sentences; however, the interaction between type of rule x polarity x linguistic form was significant ($F(9, 774) = 2.56$; $p < .0067$).

For abstract conditional arguments, the mean percentage of correct responses for MP, MT, AC and NA rules were 85.57 %, 57.25%, 25.6%, 26.99%, respectively. There were no significant differences for problems involving AC and DA rules, but post hoc comparisons (Tukey's test) showed that AC and DA arguments were significantly ($p < .05$) more difficult than the corresponding MT and MP. On the other hand, MP arguments were consistently ($p < .05$) earlier than MT arguments.

The comparisons (Tukey's test) of the mean within each type of rule indicated that arguments with AN major premises were significantly ($p < .05$) easier for MT rules. On the other hand, there were significantly less ($p < .05$) incorrect inferences DA when the subjects reasoned with conditional arguments having major premises with two negative components (NN). For AC rules, arguments involving a major premises with AA polarity were, in fact, significantly ($p < .05$) easier than those involving the denial of a component of the major premise.

Finally when they reasoned with *"if ... then"* conditional sentences and MP rules, arguments involving AA major premises were signifícantly ($p < .05$) more difficult than those with AN and NA polarity. But with *"whenever ... then"* conditional sentences and MP rules, these arguments (AA) were easier ($p < .05$) than those involving AN or NA polarity.

A final issue involves an examination of the effects of the three manipulated factors on subjective confidence in the correct subject's reasoning performance. A 2 x 4 x 4 (linguistic form x type of rule x polarity) factorial design, with repeated measures on the last

two factors was used. There was also significant main effects for type of rule F (3,258) = 72.73; p < .001). Tukey's comparisons (p < .05) revealed better security for the MP problems than those MT, AC and DA. Moreover, the confidence that a subject has about his logical performance was significantly greater (p < .05) for AC and DA problems than those MT rules.

There was also a significant type of rule x linguistic form interaction (F (3,258) = 3.52; p<. 0156). The comparisons (Tukey's test) of the means for *"if...then"* arguments and *"whenever...then"* conditionals for each type of rule, showed that MP, MT and AC rules with *"if...then"* sentences were significantly (p< .05) easier than the corresponding *"whenever...then"* premises. The DA rule was significantly (p < .05) easier for *"if ... then"* premises.

EXPERIMENT 2

The aim of this experiment is to explore the importance of: a) type of thematic content and b) factual relationship between the p and q terms of conditional sentence, on the subject´s performance and on the subject's correct response confidence.

The experiment 1 failed to show any significant difference between the performance on the "if p then q" and "whenever p then q" conditional rules. In this experiment, the materials were composed of thematic elements in a coherent relationship between antecedent and consequent of major premise. It is possible to hypothesize that such cases should produce facilitation performance.

To assess this hypothesis, in experiment 2 the degree of factual relationship between the two components of major premises was manipulated.

We also assessed the effects of different thematic content. If people reason using syntactic rules neither type of content should be more effective in itself. In contrast, if people reason using pragmatic reasoning schemas (Cheng & Holyoak, 1985, 1989; Cheng, Holyoak, Nisbett & Oliver, 1986) performance on the causal and promises/threats problems should be superior to performance in the temporal condition.

METHOD

Subjects

The subjects were ninety-six students (47 males and 49 females) at the college level (mean age 18 years, 5 months) at Santiago of Compostela (Spain).

They all participated as unpaid volunteers in this study. None of these subjects have received any instruction in logic and none of them had participated in the experiment 1.

Design

A 3 x 4 x 3 (type of content x type of conditional rule x probability of factual relation between antecedent and consequent) factorial design was used. The type of content factor had three levels: Causal content, Temporal and Promises/Threats content. This factor was manipulated between subjects, with 48 participants randomly assigned to each experimental groups.

The repatead measures on the last two factors was used. The second factor (type of conditional rule) was similar to the experiment 1. Finally, the last factor (degree of factual relation between antecedent and consequent of major premise) had three levels: Deterministic, Probabilistíc or Without Relation.

Materials

Six variations of the 24 conditional reasoning test were used. Test booklets were constructed each containing an instruction page and the conditional reasoning problems presented on separate pages.

There were 24 conditional arguments for each of three different contexts: a) Causal (IIA-1, IIA-2; vg.*"If you fall to the water then you will get wet yourself"*, b) Temporal (IIB-1, IIB-2; vg.*"if today is monday then yesterday was sunday"*

and c) Promises/Threats (IIC-1, IIC-2; vg. *"If you have the snack then I take you for a walk"*).

As in experiment 1, each booklet was prepared containing conditional arguments according to the type of logical rule (MP, MT, AC and DA). Finally, the conditional sentences differed according to the probability of factual relationship between antecedent and consequent of major premise: a) Deterministic (vg. *"if you put your hand into fire then you will burnt yourself"*), b) Probabilistic (vg. *"if you study then you pass"*) and c) Without Relation (vg. *"if you are ugly then you are pleasant"*).

These sentences were based on previous experimental work. 100 undergraduate Psychology students from the University of Santiago de Compostela were required to write 20 conditional sentences with causal content, 20 conditional sentences with temporal content and another 20 with promises/threats. A further 100 similar subjects took part in a posterior study. The subject´s task was to rate the probability of factual relation between antecedent and consequent of these conditional sentences. Finally, the conditionals with a maximum degree of agreement between the subjects were selected by the experimenters for the reasoning problems test of experiment 2.

The order of presentation of the items within each booklet was randomized as those of experiment 1.

Task and procedure

In general, the procedure was the same as that used in the previous experiment. The study was run in three experimental sessions. Thirty-three subjects were allocated at random to each of the three experimental groups (causal content, temporal content or promises/threats) in the conditional test problems.

As in experiment 1, subjects were required to select a conclusion which necessarily followed from the premises for each conditional argument and to rate the security in their selection of response. A five-point scale was used.

Subjects were given unlimited time to carry out the task.

Results

An ana1ysis of variance of the correctness of subject 's answer for each of the test item indicated that there were significant main effects for: type of rule (F (3,275 = 38.28); p< .0001), the type of content (F (2, 186) = 4.92; p<. 0093) and probability of factual relationship between antecedent and consequent of the major premise (F(2, 186) = 9.3; p< .0001).

For thematic conditional arguments, the mean percentages of correct responses for MP, MT, AC and DA rules were 83.30 %, 60.57 %, 44.97 % and 36.76%, respectively. The comparisons (Tukey´s test) for each type of rule showed that MP conditional arguments were significantly (p< .05) easier than the corresponding MT, AC and DA arguments. On the other hand, MT conditional arguments were consistently easier (p< .05) than AC and DA problems and, finally, AC items were easier (p< .05) than those of DA conditional problems.

Test of the simple main effects showed that subject´s performance with causal content was significantly (p< .05) better than the temporal and promises/threats contents. There were no significant differences for problems involving temporal content or promises/threats included in the premises.

Tukey´s test comparison for the factual relation between antecedent and consequent of conditional sentence (p< .05) demonstrated that the subjects performed better when they reasoned with deterministic relations between the two components of the major premise.

There were also a significant interactive effect between factual relation x type of content (F (4, 186) = 2.80; p< .0273 and between factual relation x type of rule (F (6, 558) = 13.79; p< .0001. Tukey´s comparisons (p < .05) indicated significantly better performance on the deterministic relation than on either of the other two types of relations, with causal content and promises/threats in the premises. But, with temporal content, the probabilistic relation between antecedent and consequent showed the

greatest performance ($p < .05$).

On the other hand, inspection of paired comparisons for the factual relation x type of rule revealed that subjects make more correct responses with the MP, MT, AC rules in the deterministic relation ($p< .05$). But also indicated that judging concerning DA inferences are often more correct with probabilistic factual relation between the two components of major premise ($p< .05$).

As in experiment 1, subjective security was examined. As in earlier experiment there was a significant main effects for the type of rule ($F (3, 279) = 14.90$; $p< .0001$). Tukey´s comparisons ($p< .05$) for the main effect of the type of rule ($F(3, 279) = 14.90$; $p< .0001$). Tukey´s comparisons ($p< .05$) for the main effect of type of rule also showed greater security on the MP problems than on the other three rules ($p< .05$). No other comparisons were significant.

Lastly, there were significant main effects for probability of factual relation ($F (2, 186) = 10.29$; $p < .0001$) and a significant interaction between factual relation x type of content ($F (4, 186) = 3.72$; $p < .0062$). Tukey's comparisons ($p < .05$) for factual relation showed significant differences in the deterministic condition and the other two relationships. Inspection of paired comparisons for the factual relation x type of content interaction showed that with temporal content the subjects rate more the security in the selection of response in the probabilistic relationship condition. Nevertheless, the deterministic relation showed the highest scores on each of the two remaining content of problems.

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